$K_a \cdot K_b = K_w$ (a = acid, b = conjugate base, w = water; or a = conjugate acid, b = base)

$K_{a\,NH_4^+} \cdot K_{b\,NH_3} = 1.0\times10^{-14}$

$NH_3 + H_2O \rightarrow NH_4^+ + OH^-$ $\quad K_b = \frac{[NH_4^+][OH^-]}{[NH_3]}$

$NH_4^+ + H_2O \rightarrow NH_3 + H_3O^+$ $\quad K_a = \frac{[NH_3][H_3O^+]}{[NH_4^+]}$

$K_a \cdot K_b = [OH^-][H_3O^+]$

$K_{b\,NH_3} = 1.8\times10^{-5}$

$K_{a\,NH_4^+} = \frac{1.0\times10^{-14}}{1.8\times10^{-5}} = 5.6\times10^{-10}$ at 25°C

Salt: NH_4Cl $\quad [H_3O^+] = [OH^-]$ (pH = 7) neutral

pH of solution be <7, 7, >7 ?

① Salt → ions

$NH_4Cl_{(s)} \rightarrow NH_{4\,(aq)}^+ + Cl_{(aq)}^-$ (dissociation equation)

② ions react with water → ionization equation.

$NH_4^+ + H_2O \leftrightarrow H_3O^+ + NH_3$

$Cl^- + H_2O \leftarrow HCl + OH^-$

③ Analyze each equation and see if $[H_3O^+]$ or $[OH^-]$ will change.

$NH_4^+ + H_2O \rightleftharpoons H_3O^+ + NH_3$

equilibrium exists; weak base; mixture will contain H_3O^+

$Cl^- + H_2O \rightleftharpoons HCl + OH^-$

no equilibrium; strong acid; only reverse reaction is happening.

no change in $[OH^-]$

④ make $[H_3O^+]$ ↑ overall ∴ solution is acidic.

Predict whether a salt is acidic, basic or neutral.

$NaCl_{(s)} \rightarrow Na^+_{(aq)} + Cl^-_{(aq)}$

$Na^+_{(aq)} + OH^-_{(aq)} \rightleftharpoons NaOH$ strong base (dissociation)

$Cl^-_{(aq)} + H_2O_{(l)} \rightleftharpoons HCl + OH^-$ strong acid

Cl^- from $NaCl$

no change in $[H_3O^+]$ or $[OH^-]$

∴ neutral salt

H_2O H_2O / H_2O / H_3O^+ OH^- $\xrightarrow{NaCl}$ H_2O H_2O / Na^+ H_2O Cl^- / that OH^-

another salt:

$KF_{(s)} \rightarrow K^+_{(aq)} + F^-_{(aq)}$

$K^+ + OH^- \rightleftharpoons KOH$ strong base

$F^- + H_2O \rightleftharpoons HF + OH^-$

equilibrium exists; weak acid

$[OH^-]$ ↑ ∴ salt is basic.

$Cu(NO_3)_2 \rightarrow Cu^{2+}_{(aq)} + 2\,NO_3^-$

$Cu^{2+} + OH^- \rightleftharpoons Cu(OH)_{2\,(s)}$ (low solubility) $[OH^-]$ ↓

$NO_3^- + H_2O \rightleftharpoons HNO_3$ strong acid $+ OH^-$

$[OH^-]$ ↓ ∴ more acidic.

process is called "Hydrolysis of a salt".

Titration: acid + base → salt

$HCl + NaOH \rightarrow NaCl + H_2O$

$HCl + NH_3 \rightarrow NH_4^+ Cl^-$

CH_3COOH (weak) + $NaOH$ (strong) → $NaCH_3COO$ (basic) $+ H_2O$

acidic basic neutral

Determine if salt is acidic, basic or neutral

$NaHSO_3$, $CrBr_3$, $FeCl_3$,

NH_4NO_3, $Ba(NO_3)_2$

answers on p530

Apr 7-1:19 PM